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10/565,302	01/20/2006	Akinori Sudoh	Q76805	7084

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EXAMINER	
BARROW, AMANDA J	

ART UNIT	PAPER NUMBER
1729	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/565,302	SUDOH ET AL.	
	Examiner	Art Unit	
	AMANDA BARROW	1729	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *10 May 2011*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-9 and 18-45* is/are pending in the application.

4a) Of the above claim(s) *18-29,35-37,39 and 40* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-9,30-34,38 and 41-45* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☐ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Status of Application

1. The Applicant's amendment filed on 5/10/11 and supplemental amendment on 5/13/2011 was received. Claims 5 and 30 were amended. No claims were cancelled.

2. The texts of those sections of Title 35, U.S.C. code not included in this action can be found in the prior Office Action issued on 8/19/2009.

Claim Rejections - 35 USC § 112

3. The claim rejection under 35 U.S.C. 112, second paragraph, on claim 5 is withdrawn as the claim has been amended.

The claim rejection under 35 U.S.C. 112, second paragraph, on claim 30 is withdrawn as the claim has been amended.

Claim Rejections - 35 USC § 103

4. The rejection under 35 U.S.C. 103(a) as being unpatentable over Ochoa et al. (US 2003/0099883 A1) on claims 1, 5, 6, 8, 30-33, 38 and 42 are maintained.

Regarding claim 1, Ochoa discloses a lithium-ion battery with electrodes including single wall carbon nanotubes to improve the capacity, thermal stability and safety of the electrode (abstract). Ochoa discloses an electrode containing carbon black ("electrode active material") and carbon nanotubes ("carbon fiber") with a diameter less than 2.0 nanometers. Ochoa teaches that the addition of carbon nanotubes ("carbon fiber") to both anodes and cathodes in amounts of

0.085 - 0.5 % (Table 3, paragraph 9) and electrode formations in which the amount of carbon nanotubes and carbon black was varied between 0.1 to 1% (paragraph 18).

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as less than 2 nm overlaps with the range of 1 to 1,000 nm and 0.085 to 1% falls within 5% or less, a prima facie case of obviousness exists for the two ranges.

Ochoa further discloses that carbon blacks consist of agglomerates of high surface carbons of fine particles which enhance adhesion among the active materials and current collectors of the electrodes. Conversely, the high surface area and difficulty of separating each particle from its agglomerate site makes carbon black a material that produces a porous electrode. High porosity tends to reduce thermal and electrical properties of electrodes and that materials with high porosity tend to exhibit decreased heat conduction and may generate heat-traps that lower the heat transfer capability. Thus, the use of carbon nanotubes can improve electrode thermal conductivity producing electrodes with a lower surface area and lower porosity (paragraphs 10, 11, 15 and 17); however, current synthesis methods of carbon nanotubes result in high cost and low yields (paragraph 4).

Therefore, it would have been obvious to a person of ordinary skill in the art to optimize the porosity of the electrode via the amount of carbon black and nanotubes added because Ochoa discloses these materials and their porosity have a direct effect on thermal and electrical properties of electrodes by way of the surface area of the materials used, as well as an effect on

the heat conduction and transfer of the electrode, and the cost of the electrode (paragraphs 4, 10, 11, 15, and 17). The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

Regarding claim 5, Ochoa teaches that the addition of carbon nanotubes (“carbon fiber”) to both anodes and cathodes in amounts of 0.085 - 0.5 % (Table 3, paragraph 9) and electrode formations in which the amount of carbon nanotubes and carbon black was varied between 0.1 to 1% (paragraph 18).

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as 0.085 to 1% falls within 5% or less, a prima facie case of obviousness exists for the two ranges.

Regarding claim 6, Ochoa discloses the length of the carbon nanometers to be up to 1 micron and with a diameter of less than 2.0 nanometers (paragraphs 3 and 18), resulting in a mean aspect ratio of approximately 500. In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, a prima facie case of obviousness exists as the claimed range overlaps with the range disclosed by Ochoa.

Regarding claim 8, Ochoa discloses that the carbon fibers are carbon nanotubes which have hollow cylindrical structures (paragraphs 3 and 18).

Regarding claim 30, Ochoa discloses an electrode containing carbon nanotubes ("carbon fiber") with a diameter less than 2.0 nanometers. Ochoa teaches that the addition of carbon nanotubes ("carbon fiber") to both anodes and cathodes in amounts of 0.085 - 0.5 % (Table 3, paragraph 9) and electrode formations in which the amount of carbon nanotubes and carbon black was varied between 0.1 to 1% (paragraph 18).

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as less than 2 nm overlaps with the range of 1 to 1,000 nm and 0.085 to 1% falls within 0.2 - 20 mass%, a prima facie case of obviousness exists for the two ranges.

Furthermore, Ochoa discloses that an electrode using 0.5 – 0.85 mass% carbon nanotubes has a capacity of 264 and 290 mA/g, respectively (Table 3). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, a prima facie case of obviousness exists for the capacity density.

Regarding claim 31, Ochoa discloses all of the claimed constituents in the claimed amounts; therefore, it is inherent to electrode that it would have the property of absorbing 3 μl of

propylene carbonate within 500 seconds at 25°C and 1 atm as claimed. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. Inherency is not established by probabilities or possibilities. *In re Robertson*, 49 USPQ2d 1949 (1999).

Regarding claims 32 and 33, Ochoa discloses that the electrode is for use in a rechargeable lithium-ion battery (abstract; paragraphs 1 and 2).

Regarding claim 38, Ochoa discloses that the active material may be carbon (paragraph 19 and Tables 1-4).

Regarding claim 42, Ochoa discloses a graphite anode with nanotubes added in which the amount of graphite is 93 mass% (Table 4, graphite anode #1). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, a prima facie case of obviousness exists. As all of the claimed constituents in the amounts claimed are present in the anode of Ochoa, it is inherent that the anode would have a bulk density of 1.7 g/cm^3 or more. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. Inherency is not established by probabilities or possibilities. *In re Robertson*, 49 USPQ2d 1949 (1999).

Furthermore, Ochoa discloses the effect of density and porosity upon thermo-electrical properties of graphite block and that increasing porosity or decreasing density lowers the thermo-electrical values of materials (paragraph 17; Table 2). Therefore, it would have been obvious to

a person of ordinary skill in the art to optimize the porosity/density of the electrode to optimize the thermo-electrical properties of the electrode (paragraph 17; Table 2). The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

5. The rejection under 35 U.S.C. 103(a) as being unpatentable over Frysz et al.: "Carbon filaments as a conductive additive to the manganese dioxide cathode of a lithium electrolytic cell;" Journal of Power Sources; vol. 58; 1996; pp. 41-54, in view of Nishimura et al. (EP 1,191,131) on claims 1, 3, 5, 6 and 30-34 is maintained.

Regarding claim 1, Frysz teaches using carbon filaments as a conductive additive to the manganese dioxide cathode of a lithium electrolytic cell (abstract). Frysz teaches that the carbon fibers used are submicron in diameter (typically ~0.1 μm) (100 nm) (pg. 42, column 1, last paragraph). Furthermore, two examples are given in which carbon fibers having diameters of 150 nm and 50 nm were used (pg. 43, column 2, third paragraph). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as 100 nm overlaps with the range of 1 to 1,000 nm, a prima facie case of obviousness exists.

Frysz further teaches that the since carbon filaments are small in diameter and exhibit high aspect ratio and high electrical conductivity, fabrication of dense electrodes is possible and

that the object of their invention is to increase the energy density by increasing the packing density, or in other words, decreasing porosity.

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the packing density (and thus the porosity) in order to increase the energy density of the electrode. The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

Frysz also discloses the weight percent of the carbon fibers at 8.2 weight percent, i.e., 8.2 mass percent (pg. 44, column 1, second paragraph). Thus, Frysz does not disclose the claimed range of 0.1 to 2 mass% as claimed; however, Nishimura discloses analogous art of introducing carbon fibers into a lithium battery electrode and teaches that the carbon fibers are preferably added in an amount of 0.1-20 mass%. Nishimura discloses amounts in excess of 20 mass % have an effect of decreasing the filling density of carbon in the electrode to thereby lower the charge-discharge capacity of the produced battery; whereas amounts less than 0.1 mass% provide a poor effect of addition (paragraph 73).

Therefore, it would have been obvious to a person of ordinary skill in the art to optimize the mass percent of carbon fibers added to the electrode of Frysz because Nishimura teaches that the fibers are preferably added in an amount of 0.1-20 mass% because amounts in excess of 20 mass % have an effect of decreasing the filling density of carbon in the electrode to thereby lower the charge-discharge capacity of the produced battery; whereas amounts less than 0.1 mass% provide a poor effect of addition (paragraph 73). The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the

ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

Regarding claim 3, Frysz discloses that the carbon fibers are treated by pluronic surfactant ("oxidation treatment") to introduce hydroxyl groups ("oxygen-containing functional group") (pg. 42, second column, last paragraph) and that almost 80 mAh/g active material more cpapacity was achieved with surfactant treatment of the filaments (pg. 47, column 2, first paragraph).

Furthermore, it is noted that claim 2 is a product-by-process claim, even though Frysz discloses all the elements claimed including the process ("oxidation treatment"). "Even though product-by-process claims are limited by and defined by the process, determination of patentability is based on the product itself. The patentability of a product does not depend on its method of production. If the product in the product-by-process claim is the same as or obvious from a product of the prior art, the claim is unpatentable even though the prior product was made by a different process." *In re Thorpe*, 777 F.2d 695, 698, 227 USPQ 964, 966 (Fed. Cir. 1985) (see MPEP § 2113).

Regarding claim 5, Frysz discloses the amount of carbon fiber at 8.2 weight percent, i.e., 8.2 mass percent (pg. 44, column 1, second paragraph). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05.

Regarding claim 6, Frysz discloses that diameters of the carbon filaments in the experimental section as 150 nm and 50 nm with lengths in excess of 100 micrometers (100,000 nm). The aspect ratio is thus 670 and 2,000, respectively. In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the taught range and examples lie inside the claimed range, a prima facie case of obviousness exists.

Regarding claim 30, Frysz teaches that the carbon fibers used are submicron in diameter (typically ~0.1 μm) (100 nm) (pg. 42, column 1, last paragraph). Furthermore, two examples are given in which carbon fibers having diameters of 150 nm and 50 nm were used (pg. 43, column 2, third paragraph). Frysz discloses the weight percent of the carbon fibers at 8.2 weight percent, i.e., 8.2 mass percent (pg. 44, column 1, second paragraph). Frysz discloses the capacities of multiple electrodes incorporating the carbon fibers which have densities higher than 100 mAh/g (Table 1).

In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, a prima facie case of obviousness exists for all three claimed ranges.

Regarding claim 31, Frysz discloses that the main factors related to high capacity in an electrode are cathode electrolyte absorptivitiy and electrolyte absorption rate (pg. 47, column 2,

first paragraph). Frysz further discloses that the primary factor relating to this is the shape of the carbon filaments with the high aspect ratio which produces a channel-like pore structure within the cathode which facilitates flowability of electrolyte into the cathode. This easier flow of electrolyte allows a larger quantity of electrolyte to be held by the cathode and the rate of adsorption of the electrolyte into the cathode to be higher. The availability of electrolyte to promote ionic conduction and the ability of the carbon filament to rapidly transfer electrons decrease the degree and rate of polarization, thereby extending the useable life of the cathode and yielding a discharge curve with a gently sloping end-of-life (pg. 52, first column, first paragraph).

Therefore, it would have been obvious to a person of ordinary skill in the art to optimize the absorptivity rate of electrolyte by the electrode as this is a main factor in creating a high capacity electrode (pg. 47, column 2, first paragraph; pg. 52, first column, first paragraph). The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

Regarding claims 32 and 33, Frysz discloses the cathode as an element in a lithium secondary battery.

Regarding claim 34, Frysz discloses the electrolyte comprises a non-aqueous electrolyte using the solvent propylene carbonate (pg. 44, column 1, third paragraph).

6. The rejection under 35 U.S.C. 103(a) as being unpatentable over Nishimura et al. (EP 1,191,131) in view of Ochoa et al. (US 2003/0099883 A1) on claims 1, 2, 4-9, 30, 32-34, 38, 42 and 43 are maintained.

Regarding claims 1 and 5, Nishimura discloses carbon fibers used as a filler added to a positive and/or negative electrode for any of a variety of batteries including a lithium ion secondary battery in order to improve the charge-discharge capacity and mechanical strength of the electrode (paragraphs 2 and 23). In an example of the formation of an electrode, graphite particles serving as the active material are mixed with the carbon fibers (i.e., "carbon filament") of Nishimura's invention (Example 8).

Nishimura discloses the carbon fibers preferably have a fiber diameter of 0.1-1 μm, i.e., 100-1000 nm (paragraph 31). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the taught range and examples lie inside the claimed range of 1 to 1,000 nm, a prima facie case of obviousness exists.

Nishimura teaches that the carbon fibers are preferably added in an amount of 0.1-20 mass%. Nishimura discloses amounts in excess of 20 mass % have an effect of decreasing the filling density of carbon in the electrode to thereby lower the charge-discharge capacity of the produced battery; whereas amounts less than 0.1 mass% provide a poor effect of addition (paragraph 73).

Therefore, it would have been obvious to a person of ordinary skill in the art to optimize the mass percentage of carbon fibers in the electrode of Nishimura to an amount ranging from 0.1 to 20 mass% because Nishimura teaches carbon fibers in excess of 20 mass % have an effect of decreasing the filling density of carbon in the electrode to thereby lower the charge-discharge capacity of the produced battery; whereas amounts less than 0.1 mass% provide a poor effect of addition (paragraph 73). The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

Furthermore, in the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the claimed range of less than 5 mass% overlaps with the taught range of 0.1 – 20 mass%, a prima facie case of obviousness exists.

Nishimura is silent as to the porosity of the electrode; however, Ochoa discloses analogous art in which carbon nanotubes are added to a lithium-ion battery electrode in order to improve the capacity, thermal stability and safety of the electrode (abstract). Ochoa discloses an analogous electrode to that of Nishiumura containing carbon as an electrode active material and carbon nanotubes as an additive (Table 4). Ochoa discloses that high porosity tends to reduce thermal and electrical properties of electrodes and that materials with high porosity tend to exhibit decreased heat conduction and may generate heat-traps that lower the heat transfer

capability and that use of carbon nanotubes can improve electrode thermal conductivity producing electrodes with a lower surface area and lower porosity (paragraphs 10, 11, 15 and 17); however, current synthesis methods of carbon nanotubes result in high cost and low yields (paragraph 4).

Therefore, it would have been obvious to a person of ordinary skill in the art to optimize the porosity of the electrode via the amount of carbon black and nanotubes added because Ochoa discloses these materials and their porosity have a direct effect on thermal and electrical properties of electrodes by way of the surface area of the materials used, as well as an effect on the heat conduction and transfer of the electrode, and the cost of the electrode (paragraphs 4, 10, 11, 15, and 17). The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

Regarding claim 2, Nishimura discloses that the fine carbon fibers have undergone a heat treatment of 2000° C or higher resulting in a highly crystalline carbon fiber, i.e., a graphite carbon fiber (paragraphs 23 and 25).

Regarding claim 4, Nishimura discloses a highly crystalline carbon fiber, i.e., a graphite carbon fiber which contains boron in an amount of 0.1-10 mass%, i.e., 1000-100,000 ppm (paragraph 23). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP

2144.05. Therefore, as the taught range lies inside the claimed range, a prima facie case of obviousness exists.

Regarding claim 6, Nishimura discloses the carbon fibers have an aspect ratio of 10 or more (paragraph 23), and more preferably 50 or more (paragraph 31). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the taught range lies inside the claimed range, a prima facie case of obviousness exists.

Regarding claim 7, Nishimura discloses that the crystalline carbon fiber has an interlayer distance d_{002} between carbon layers as determined by x-ray diffraction method in a range of 0.335-0.342 (page 3, lines 57-58) which falls in the claimed range of 0.344 nm or less. In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05.

Regarding claim 8, Nishimura discloses that the carbon fibers produced include expanded carbon fibers and other fibrous carbons (paragraph 2) in which boron crystals are contained within the fibers (paragraph 23); thus, a “hollow inner structure” is present within the carbon fiber.

Regarding claim 9, Nishimura discloses that the carbon fiber may be a branched carbon fiber (abstract; paragraphs 2 and 42).

Regarding claims 30, Nishimura discloses the carbon fibers preferably have a fiber diameter of 0.1-1 μm, i.e., 100-1000 nm (paragraph 31). Nishimura teaches that the carbon fibers are preferably added in an amount of 0.1-20 mass%. Nishimura discloses that the capacity density of the electrode formed ranges from 282-332 mAh/g (Table 4; example 8-1 and 8-2 and their comparative examples). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the taught ranges and examples lie inside the claimed ranges, a prima facie case of obviousness exists.

Regarding claims 32 and 33, Nishimura discloses the incorporation of the fibers into a positive and negative electrode for any of a variety of batteries, and specifically recites a Li ion secondary battery (paragraph 2).

Regarding claim 34, Nishimura discloses a lithium secondary battery in which a nonaqueous electrolyte is used using a non-aqueous solvent such as ethylene carbonate (paragraph 107).

Regarding claim 38, Nishimura discloses that a carbonaceous material serves as the negative electrode material of a battery (paragraph 110 - Example 8).

Regarding claim 42, Nishimura discloses that the graphite material serving as the carbonaceous active material in the electrode is in an amount of 87-94% (paragraphs 110, 111

and Table 3). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the taught ranges and examples lie inside the claimed ranges, a prima facie case of obviousness exists.

Nishimura does not recite the bulk density of the electrode; however, Ochoa discloses the effect of density and porosity upon thermo-electrical properties of graphite (paragraph 17; Table 2). Ochoa discloses that increasing porosity or decreasing density lowers the thermo-electrical values, effects heat conduction and increases heat-traps that lower the heat transfer capability (paragraphs 10, 11, 17).

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the density of Nishimura's electrode because Ochoa discloses that density alters the thermo-electrical properties of the active material, increases heat-traps that lower the heat transfer capability and effects heat conduction (paragraphs 10, 11 and 17). The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

Regarding claim 43, Nishimura discloses that the graphite material serving as the carbonaceous active material in the electrode is incorporated with boron during heat treatment (paragraph 110).

7. The rejection under 35 U.S.C. 103(a) as being unpatentable over Nishimura et al. (EP 1,191,131) in view of Ochoa et al. (US 2003/0099883 A1) as applied to claims 1, 2, 4-9, 30, 32-34, 38, 42 and 43 above, and further in view of Frysz et al.: "Carbon filaments as a conductive additive to the manganese dioxide cathode of a lithium electrolytic cell; "Journal of Power Sources; vol. 58; 1996; pp. 41-54, on claims 3 and 45 is maintained.

Regarding claim 3, Nishimura discloses the graphite carbon fiber but does not disclose that oxygen-containing functional groups are introduced to the surface of said carbon fibers; however Frysz discloses analogous art of the addition of carbon filaments to electrodes (abstract), and that the carbon fibers are treated by pluronic surfactant (“oxidation treatment”) to introduce hydroxyl groups to the surface of the fibers ("oxygen-containing functional group") (pg. 42, second column, last paragraph), and that almost 80 mAh/g active material more capacity was achieved with surfactant treatment of the filaments (pg. 47, column 2, first paragraph). Frysz also discloses that the packing density and electron transfer rate are enhanced by surface treatment of the carbon (abstract).

Therefore, it would have been obvious to one of ordinary skill in the art to modify the carbon fibers of Nishimura to have oxygen-containing functional groups because Fyrsz discloses carbon fibers having oxygen-containing surface groups and that this results in an increased capacity, enhanced packing density and a better electron transfer rate (pg. 47, column 2, first paragraph; abstract).

Regarding claim 45, Nishimura discloses that the graphite material serving as the carbonaceous active material in the electrode is in an amount of 87-94% (paragraphs 110, 111 and Table 3). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the

prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the taught ranges and examples lie inside the claimed ranges, a prima facie case of obviousness exists.

Nishimura is silent as to the graphite particles C_0 of a 002 plane, La, Lc, BET specific surface area, true density and laser Raman R values; however, Frysz discloses that the electrical conductivity, electrolyte absorptivity, surface area, porosity, and mechanical properties of batteries are all affected by the type of carbon additive used. Frysz also teaches that the performance of the electrodes for electrochemical cells is dependent upon the particle size and shape of the carbon and that the structure of carbon black significantly influences the absorption capacity of an electrode which in turn, influences the overall capacity of the cell (columns 1 and 2). The claimed values (C_0 of a 002 plane, La, Lc, BET specific surface area, true density and laser Raman R) are all dependent upon the type of carbon, particle size and shape and structure of the carbon chosen.

Therefore, it would have been obvious to a person of ordinary skill in the art to optimize the type of graphite material of Nishimura, and thus in turn the claimed values, because the electrical conductivity, electrolyte absorptivity, surface area, porosity, and mechanical properties of batteries are all affected by the type of carbon additive used; the performance of the electrode is dependent upon the particle size and shape of the carbon; and the structure of the carbon significantly influences the absorption capacity of an electrode which in turn, influences the overall capacity of the cell (columns 1 and 2). The discovery of an optimum value of a known

result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

8. The rejection under 35 U.S.C. 103(a) as being unpatentable over Nishimura et al. (EP 1,191,131) in view of Ochoa et al. (US 2003/0099883 A1) as applied to claims 1, 2, 4-9, 30, 32-34, 38, 42 and 43 above, or alternatively under 35 U.S.C. 103(a) as being unpatentable over Nishimura et al. (EP 1,191,131) in view of Ochoa et al. (US 2003/0099883 A1) and Frysz et al.: "Carbon filaments as a conductive additive to the manganese dioxide cathode of a lithium electrolytic cell;" Journal of Power Sources; vol. 58; 1996; pp. 41-54, on claim 31 is maintained.

Regarding claim 31, given that the electrode of Nishimura contains all of the claimed constituents in the amounts claimed, the electrode would inherently absorb 3 μl of propylene carbonate within 500 seconds at 25°C and 1 atm. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. Inherency is not established by probabilities or possibilities. *In re Robertson*, 49 USPQ2d 1949 (1999).

Alternatively, Frysz discloses analogous art of the addition of carbon filaments to electrodes (abstract), and that the main factors related to high capacity in an electrode are electrode electrolyte absorptivitiy and electrolyte absorption rate (pg. 47, column 2, first paragraph). Frysz further discloses that the primary factor relating to this is the shape of the carbon filaments with the high aspect ratio which produces a channel-like pore structure within the cathode which facilitates flowability of electrolyte into the cathode. This easier flow of

electrolyte allows a larger quantity of electrolyte to be held by the cathode and the rate of adsorption of the electrolyte into the cathode to be higher. The availability of electrolyte to promote ionic conduction and the ability of the carbon filament to rapidly transfer electrons decrease the degree and rate of polarization, thereby extending the useable life of the cathode and yielding a discharge curve with a gently sloping end-of-life (pg. 52, first column, first paragraph).

Therefore, it would have been obvious to a person of ordinary skill in the art to optimize the absorptivity rate of electrolyte of Nishimura's electrode because Ochoa discloses that the absorptivity rate of electrolyte is a main factor in creating a high capacity electrode (pg. 47, column 2, first paragraph; pg. 52, first column, first paragraph). The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

9. The rejection under 35 U.S.C. 103(a) as being unpatentable over Nishimura et al. (EP 1,191,131) in view of Ochoa et al. (US 2003/0099883 A1) as applied to claims 1, 2, 4-9, 30, 32-34, 38, 42 and 43 above, and further in view of Kubota et al. (US 6,139,990) on claims 41 and 44 is maintained.

Regarding claims 41 and 44, Nishimura discloses that the carbonaceous material serving as the negative electrode material of a battery is heat treated to form graphite particles having an average particle size of 16 μm (paragraph 110). Nishimura discloses that the graphite material serving as the carbonaceous active material in the electrode is in an amount of 87-94%

(paragraphs 110, 111 and Table 3). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the taught ranges and examples lie inside the claimed ranges, a prima facie case of obviousness exists.

Nishimura does not disclose the average roundness of the particles; however, Kubota discloses analogous art of modified graphite particles and there use in secondary batteries as a negative electrode material which have a degree of circularity of not less than 0.86 resulting in a decrease in discharge capacity at high discharge current values (abstract; column 6, lines 55-67).

Therefore, it would have been obvious to a person of ordinary skill in the art to modify the graphite particles used in Nishimura to have a degree of circularity of not less than 0.86 because Kubota teaches that the use of graphite particles with this parameter in an electrode of a battery results in a decrease in discharge capacity at high discharge current values (abstract; column 6, lines 55-67).

10. The rejection under 35 U.S.C. 103(a) as being unpatentable over Nishimura et al. (EP 1,191,131) in view of Ochoa et al. (US 2003/0099883 A1) as applied to claims 1, 2, 4-9, 30, 32-34, 38, 42 and 43 above, and further in view of Kitagawa et al. (US 2002/0061445) on claim 45 is maintained.

Regarding claim 45, Nishimura discloses that the graphite material serving as the carbonaceous active material in the electrode is in an amount of 87-94% (paragraphs 110, 111

and Table 3). In the case where the claimed ranges "overlap or lie inside ranges disclosed by the prior art" a prima facie case of obviousness exists. In re Wertheim, 541 F.2d.257, 191 USPQ 90 (CCPA 1976); *In re Woodruff*, 919 F.2d 1575, 16 USPQ2d 1934 (Fed. Cir. 1990); *In re Geisler*, 116 F.3d 1465, 1469-71, 43 USPQ2d 1362, 1365-66 (Fed Circ. 1997). See MPEP 2144.05. Therefore, as the taught ranges and examples lie inside the claimed ranges, a prima facie case of obviousness exists.

Nishimura is silent as to the graphite particles C_0 of a 002 plane, La, Lc, BET specific surface area, true density and laser Raman R value; however, Kitagawa discloses a secondary cell utilizing a battery in which the graphite powder has a Lc of at least 1000 angstroms (100 nm) or more (paragraph 13); has a Raman R , that is the peak intensity of 1360 cm^{-1} in relation to the peak intensity of 1580 cm^{-1} of 0.3 or less (paragraph 14); a BET specific surface area of 3.5 m^2/g or more and not exceeding 10 m^2/g (paragraph 14); a mean particle size of 10-30 microns (paragraph 15) and a mean roundness ranging from 0.918-0.966 (Table 1). Kitagawa is silent as to the C_0, La and true density of the graphite; however, given the other five parameters of the graphite claimed are matched by Kitagawa, it is the position of the Examiner that the graphite material used in Kitagawa is nearly identical to that claimed and would have the values falling within the claimed ranges for C_0, La and true density. A reference which is silent about a claimed invention's features is inherently anticipatory if the missing feature is necessarily present in that which is described in the reference. Inherency is not established by probabilities or possibilities. *In re Robertson*, 49 USPQ2d 1949 (1999).

Furthermore, Kitagawa discloses that the graphite material for a negative electrode achieves at least 95% of the theoretical value of specific capacity, while its irreversible capacity

is extremely small, by which it contributes to the enhancement of energy density (paragraph 89). Moreover, the graphite material provides not only excellent high rate charge and discharge performances and low temperature high rate discharge performance, but presents a highly reliable battery which is free from electrolyte accident even left at a high temperature (paragraph 89).

Therefore, it would have been obvious to use the graphite of Kitagawa with the specific parameters disclosed as the graphite material of Nishimura because Kitagawa teaches that the graphite material achieves at least 95% of the theoretical value of specific capacity, has an extremely small irreversible capacity by which it contributes to the enhancement of energy density, has an excellent high rate charge and discharge performance, low temperature high rate discharge performance, and presents a highly reliable battery which is free from electrolyte accident even left at a high temperature (paragraph 89).

Response to Arguments

11. Applicant's arguments filed 5/10/2011 have been fully considered but they are not persuasive.

Applicant's remaining principal arguments are

<u>Regarding the rejection under Ochoa</u>

(a) Applicant states that the Examiner appears to have misconstrued the carbon black as the electrode active substance and cites Tables 3 and 4 and paragraph 18 of Ochoa to show that the carbon fiber is the active substance whereas the carbon black and carbon nanotubes are

the additives. Thus, Applicant goes on to argue that the negative electrode active substance is substantially different from that of the present invention.

(b) Ochoa does not disclose, teach or suggest an electrode having a low porosity of 25% or less. Moreover, Ochoa teaches away from an electrode having a low porosity as Ochoa discloses that increasing porosity to lower thermoelectrical conductivity is preferable due to ease of manufacture.

(c) Applicant provides a porosity calculation for cathode #1 noting that the porosity of this cathode is not 25% or less.

Regarding the rejection under Frysz

(d) Frysz does not disclose an electrode having a porosity of 25% or less. Applicants provide some calculations of one of the Examples of Frysz.

Regarding the rejection under Nishimura

(e) Nishimura does not disclose an electrode having a porosity of 25% or less. Furthermore, Ochoa nor Frysz disclose an electrode porosity of 25% as claimed. Nishimura also does not inherently disclose an electrode porosity of 25% or less.

In response to Applicant's arguments, please consider the following comments.

(a) Giving the claims their broadest reasonable interpretation, an "electrode active substance" is merely a substance within an electrode providing some function or activity. Thus, the Examiner's interpretation of the carbon black of Ochoa as an "electrode active substance" fits within this reasonable interpretation, as carbon black is not only capable of electronic conductivity, but also the intercalation of alkali metals. Thus, Applicants argument of the

negative electrode active substance being substantially different from that of the present invention is moot. Furthermore, independent claim 1 fails to recite the specificities of the electrode active substance, only reciting that the electrode contains an electrode active substance.

(b) Ochoa does provide teaching, suggestion and motivation to alter the porosity of the electrode as outlined in the non-final rejection issued on 1/10/11. Specifically, Ochoa discloses that carbon blacks consist of agglomerates of high surface carbons of fine particles which enhance adhesion among the active materials and current collectors of the electrodes. Conversely, the high surface area and difficulty of separating each particle from its agglomerate site makes carbon black a material that produces a porous electrode. ***High porosity tends to reduce thermal and electrical properties of electrodes and that materials with high porosity tend to exhibit decreased heat conduction and may generate heat-traps that lower the heat transfer capability. Thus, the use of carbon nanotubes can improve electrode thermal conductivity producing electrodes with a lower surface area and lower porosity*** (paragraphs 10, 11, 15 and 17).

Thus, while Ochoa teaches that increasing porosity to lower thermoelectrical conductivity is preferable due to ease of manufacture as pointed out by the Applicant, one cannot disregard that Ocho ***also*** teaches that, "High porosity tends to reduce thermal and electrical properties of electrodes" (paragraph 10) and that porosity generates heat-traps that lower the heat transfer capability of composite systems such as electrodes and that materials with high porosity tend to exhibit decreased heat conduction (paragraph 11). Hence, the optimization of the porosity of the electrode would have been obvious to one of ordinary skill in the art to balance the properties of

thermal and electrical properties, ease of manufacture, heat conduction and transfer within the electrode and the cost of the electrode (paragraphs 4, 10, 11, 15 and 17).

(c) This example is not relevant to the claim rejection as there is no carbon black within the electrode. Furthermore, porosity calculations would have to be done for each and every example given in order to conclude that Ochoa does not teach an example of an electrode which is 25% or less. Even then, Ochoa still provides teaching, suggestion and motivation to optimize the porosity as discussed in section (b) above and in the non-final issued on 1/10/11.

(d) Frysz provides teaching, suggestion and motivation to optimize the packing density (i.e., the porosity) of the electrode. Specifically, Frysz teaches that the since carbon filaments are small in diameter and exhibit high aspect ratio and high electrical conductivity, ***fabrication of dense electrodes is possible and that the object of their invention is to increase the energy density by increasing the packing density***, ***or in other words, decreasing porosity***. Thus, as outlined in the non-final rejection issued on 1/10/2011, it would have been obvious to a person of ordinary skill in the art to increase the packing density (and thus decrease the porosity) in order to increase the energy density of the electrode. The discovery of an optimum value of a known result effective variable, without producing any new or unexpected results, is within the ambit of a person of ordinary skill in the art. See *In re Boesch*, 205 USPQ 215 (CCPA 1980) (see MPEP § 2144.05, II.).

(e) The Examiner noted that Nishimura is silent as to the porosity of the electrode and presented the optimization argument taught by Ochoa for modifying the porosity of the electrode as this has a direct effect on thermal and electrical properties of the electrodes, heat conduction and transfer within the electrode and cost of the electrode (paragraphs 4, 10, 11, 15 and 17). Per

the inherency argument, the Examiner did not make this argument; thus, Applicants argument on this is moot.

Conclusion

12. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the mailing date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to AMANDA BARROW whose telephone number is (571)270-7867. The examiner can normally be reached on 7:30am-5pm EST. Monday-Friday, alternate Fridays off.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Ula Ruddock can be reached on 571-272-1481. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

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